Railway Group Standard
GM/RT2466
Issue Three
Date February 2010

Railway Wheelsets

Synopsis
This document mandates requirements for the design, manufacture and maintenance of wheelsets and their components.

This document contains requirements that are amended under the Railway Group Standards Code (Issue Three) as a small scale change. Reference to the amended requirements is made in the ‘Issue record.'
Issue record

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<td>Supersedes issue one</td>
</tr>
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<td>Small scale change amendment – addition to Table 1 and associated note together with new clause 2.9.3, correction of reference in 4.9.1.1, revision of 4.18.1, addition of new clause 4.18.2 (following clauses re-numbered), revised drawing number in Table A.1 in Appendix A, new Appendix D and note to identify where drawings can be obtained.</td>
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Amended or additional parts of revised pages have been marked by a vertical black line in the adjacent margin.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

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<td>All</td>
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Supply

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Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document mandates requirements for the design, manufacture and maintenance of wheelsets and their components.

1.2 Introduction

1.2.1 Background

1.2.1.1 The implementation of the Technical Specifications for Interoperability (TSIs) mandated through a series of European Union Directives has resulted in a review of all requirements mandated in Railway Group Standards.

1.2.1.2 Under the Strategy for Standards Management Rail Safety and Standards Board (RSSB) has given a commitment to review all of its standards with a view to mandating only those requirements that define the interface and the need for co-operation between different categories of duty-holder to manage risk safely.

1.2.1.3 A review of the requirements set out in standards associated with railway wheelsets has resulted in a revised Railway Group Standard on this topic.

1.2.2 Principles

1.2.2.1 The requirements of this document are based on one of the following principles:

a) This document mandates only those requirements that define the interface and the need for co-operation between different categories of duty-holder to manage risk safely.

b) This document mandates requirements that are necessary only to support an Open Point in a TSI and meet an essential requirement of the relevant EU Directive.

c) This document mandates requirements that are necessary only for interworking on non TSI compliant GB infrastructure.

1.2.3 Support to Essential Requirements

1.2.3.1 The EU Directives applicable to Interoperability mandate that each TSI is required to address a number of essential requirements. In supporting specific open points in Rolling Stock TSIs, in particular the as yet un-published Conventional Rail Rolling Stock TSIs, the following essential requirements are addressed.

1.2.3.2 The directive 2001/16/EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the conventional rail system together with the consolidated legal version (without preamble) according to Directive 2004/50/EC of 29 April 2004 contains within Annex 3 Essential Requirements the following relevant essential requirements.

General Requirements

Safety

1.1.3. The components used must withstand the normal or exceptional stresses that have been specified during their period of service. The safety repercussions of any accidental failures must be limited by appropriate means.
1.2.4 Supporting documents

1.2.4.1 The following Railway Group documents support this Railway Group Standard:

a) GM/RC2494 Recommendations for Railway Wheelset Design

b) GM/RC2495 Recommendations for Railway Wheelset Manufacture

c) GM/RC2496 Recommendations for Railway Wheelset Maintenance

d) GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage Identification

e) GM/GN2498 Guidance on Railway Wheelset Handling [proposed].
Part 2 Requirements for Design

2.1 Methodology
2.1.1 To achieve consistency within a chosen methodology and industry practice where British Standards, European Standards or Association of American Railroads (AAR) standards are adopted to comply with this standard the applicable full suite of British Standards, European Standards or AAR standards shall be applied. Except where otherwise defined within this document, it is not permissible to use selected elements only, nor mix between the regimes for design, manufacture and maintenance of railway wheelsets.

2.1.2 Wheelsets shall be designed using actual, or predictions, of service loads so that the fatigue life is not finite. The design shall withstand all the foreseeable inputs under which the vehicle is to remain fully operational. The design shall be capable of being manufactured and maintained in accordance with this document.

2.1.3 All new designs of wheelset shall be validated using methods appropriate to the application to demonstrate that the design satisfies the requirements of the standards and complies with the requirements set out in this document.

2.1.4 GM/RC2494 provides recommendations for wheelset design, in particular requirements for applications in the UK.

2.2 Axle design
2.2.1 Axles shall be designed using a proven method to satisfy the requirements of 2.1 of this document.

2.2.2 The axle design shall define the non-destructive testing (NDT) requirements for manufacturing and all phases of the wheelset life.

2.3 Wheel design
2.3.1 New wheelset designs shall use monobloc design wheels.

2.3.2 The width of the wheel rim (the distance between the flange back and the outside face of the rim) shall be within the range 127 to 150 mm.

2.3.3 For monobloc wheels only, it is permissible to reduce the rim thickness at the final re-profiling such that the fatigue life of the wheel rim becomes finite. The predicted fatigue life of the wheel after the final re-profiling shall be not less than three times the remaining service life.

2.3.4 New wheel designs shall make provision for balancing without the need for holes in the wheel.

2.4 Axle bearing design
2.4.1 The axle bearing design life shall be determined using a proven method.

2.5 Flange design
2.5.1 The nominal flange angle of a new tread profile design shall be in the range 68° to 70°.

2.5.2 The radius between the flange tip and the flange back blend, when new, shall not be less than 10 mm.

2.5.3 The flange toe radius, when new, shall not be less than 10 mm.
2.6 Selection of tread profiles

2.6.1 The wheel tread profile for new wheelset designs shall be selected from those listed in Appendix A. The tread profile shall be chosen to suit the vehicle and suspension design, taking account of the effect on the wheel / rail interface, vehicle dynamics, and wheel / rail wear and maintenance.

2.7 Materials

2.7.1 Axle and wheel materials shall be selected from the range defined in 2.8, Axle materials, and 2.9, Monobloc wheel material, consistent with the chosen design methodology.

2.8 Axle materials

2.8.1 The axle material shall be selected from the following:

- a) BS EN 13261 Grades A1T, A4T or A1N
- b) BS 5892, Part 1, Grade A1T or Grade A4T. The hydrogen content shall be in accordance with BS EN 13261.
- c) Association of American Railroads standard M-101 Grade F.

2.9 Monobloc wheel material

2.9.1 The wheel material shall be selected from approved grades of steel for particular applications as set out in Table 1.

<table>
<thead>
<tr>
<th>Wheel type</th>
<th>BS 5892, Part 3</th>
<th>BS EN 13262 (only applies to rim chilled wheels)</th>
<th>AAR</th>
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</thead>
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<tr>
<td>Freight, integral brake disc wheel</td>
<td>R7E</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Freight, cheek mounted brake disc wheel</td>
<td>R8E</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Other freight wheels</td>
<td>R7T or R8T</td>
<td>ER7 or ER8</td>
<td>M-107/M-208 class B</td>
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<tr>
<td>All passenger vehicle</td>
<td>R8T or RS8T</td>
<td>ER8</td>
<td>X</td>
</tr>
<tr>
<td>Other wheels</td>
<td>R8T</td>
<td>ER8</td>
<td>M-107/M-208 class B</td>
</tr>
</tbody>
</table>

Table 1 Monobloc wheel material

Notes: RS8T is not recommended for use on tread braked wheel applications.

- X No approved grades of steel available.

2.9.2 Monobloc wheels manufactured in accordance with the requirements of BS 5892 Part 3 shall have hydrogen content in accordance with BS EN 13262.

2.9.3 Monobloc wheels manufactured by the quenched and tempered heat treatment process in accordance with UIC 812-3 (withdrawn) shall comply with the requirements as set out in Appendix D.
2.10 Wheelset assembly

2.10.1 Wheels, and other components that are secured to the axle by interference fit, shall be designed to remain secure for the service life and over the wheelset full operational temperature range, including thermal effects of the environment and service operation.
Part 3 Requirements for Manufacture and Assembly

3.1 Supporting information
3.1.1 GM/RC2495 provides recommendations for manufacture and assembly of railway wheelsets, in particular requirements for applications in the UK.

3.2 Materials
3.2.1 Steel properties
3.2.1.1 All materials shall be sampled to demonstrate that the material from which the component is manufactured is homogeneous and free from macro-segregation that is likely to have a detrimental effect on performance. The metallurgical content shall be consistent with material grade. Failure to satisfy the requirements of the specified tests shall result in the complete batch of components being rejected.

3.2.2 Axle material
3.2.2.1 Axles shall be manufactured using the material defined by their design.

3.2.3 Monobloc wheel material
3.2.3.1 Monobloc wheels shall be manufactured using the materials defined by the design.

3.2.4 Wheel centre material
3.2.4.1 Wheel centres shall be manufactured to the requirements of BS 5892 Part 2. The approved grade of steel is Grade U.

3.2.5 Tyre material
3.2.5.1 Replacement tyres to be fitted to wheelsets of existing designs shall be manufactured to the requirements of BS 5892 Part 4.
3.2.5.2 The approved grades of steel are either B5E or B6E, dependant upon the application.

3.2.6 Retaining (Gibson) ring material
3.2.6.1 Retaining rings shall be manufactured to the requirements of BS 5892, Part 5.

3.2.7 Other material
3.2.7.1 Any wheelset components not described above shall be manufactured to the requirements of the applicable British Standard or European Standard. The materials and processes shall be selected and controlled to ensure that the finished components perform their intended duty safely.
3.3 Component testing

3.3.1 Axle testing

3.3.1.1 Axles manufactured in accordance with BS 5892 Part 1 shall be subject to all the mandatory tests listed. They shall also be subject to the following optional tests in BS 5892 Part 1:

a) Impact test (BS 5892 Part 1 clause 8.3.4)

b) Ultrasonic testing (BS 5892 Part 1 clause 9.3.1) to demonstrate that the axle body is transparent to ultrasound

c) Magnetic particle inspection (MPI) (BS 5892 Part 1 clause 9.3.2), or inspection process of at least equivalent sensitivity, over the whole surface area, excluding the axle ends. This testing shall be carried out after finish machining and prior to fitment of any components.

3.3.1.2 Axles manufactured in accordance with BS 5892 Part 1 shall also be subject to the micrographic cleanliness examination requirements set out in BS EN 13261 clause 3.4.1.

3.3.1.3 Axles designed in accordance with the requirements of BS EN 13103 or BS EN 13104 shall satisfy the requirements for axle testing set out in BS EN 13261.

3.3.1.4 Axles designed in accordance with AAR regulations shall be tested in accordance with the requirements of AAR standard M-101. In addition the axles shall be subject to magnetic particle inspection (BS 5892 Part 1, 9.3.2), or an inspection process of at least equivalent sensitivity, over the whole surface area, excluding the axle ends. This testing shall be carried out after finish machining and prior to fitment of any components.

3.3.1.5 For the detection method chosen in accordance with the design requirements, no detectable transverse cracks in the axle shall be permissible.

3.3.2 Monobloc wheel testing

3.3.2.1 Monobloc wheels manufactured in accordance with BS 5892, Part 3 shall be subject to all the mandatory tests listed. They shall also be subject to the following optional tests in BS 5892, Part 3:

a) Uniformity of rim hardness (BS 5892, Part 3, section 8.3.6.1).

b) Ultrasonic test (BS 5892, Part 3, section 8.3.7). The wheel rims shall be ultrasonically tested for internal defects. It is permissible to ultrasonically test the wheel rim using the method specified in BS EN 13262.

The rejection criteria for the defect level shall be dependent upon the application as follows:

i) Wheelsets operating up to 125 mile/h – defect larger than 2 mm

ii) Wheelsets operating above 125 mile/h – defect larger than 1 mm.

c) Residual stress for rim chilled wheels (BS 5892, Part 3, 10.6).

3.3.2.2 Monobloc wheels manufactured in accordance with BS 5892, Part 3 shall also be subject to the micrographic cleanliness examination requirements set out in BS EN 13262 clause 3.4.1.
3.3.2.3 Monobloc wheels that have been approved in accordance with BS EN 13979-1 for their design shall satisfy the test requirements as set out in BS EN 13262.

3.3.2.4 Monobloc wheels manufactured in accordance with the requirements of AAR specification M-107/M-208 for their design shall satisfy the test requirements set out in M-107/M-208.

3.3.3 Tyre testing

3.3.3.1 Tyres shall be subject to the mandatory tests and optional requirements of BS 5892, Part 4 to ensure the safety and integrity of the tyre. It is permissible to ultrasonically test the tyre using the method specified in BS EN 13262 with a defect ≥ 2 mm being a cause for rejection. The ultrasonic testing dead zone shall be no greater than 10 mm from the test surface.

3.4 Assembly

3.4.1 Assembly of wheelsets

3.4.1.1 Wheelsets shall be assembled in accordance with the requirements of the respective standard, BS EN 13260 or BS 5892 Part 6 or AAR Manual of Standards and Recommended Practices Section G - Part II.

3.4.1.2 Wheelsets shall be measured and inspected in accordance with the applicable standard. The following inspections shall be included:
   a) Conformity of back-to-back dimension, as set out in 4.16 of this document
   b) Conformity of tread profile as selected from Appendix A of this document.

3.4.2 Assembly of other components

3.4.2.1 Other components, bearings, axleboxes, brake discs, etc fitted to the wheelset shall not damage or adversely affect the integrity of the assembled wheelset.

3.4.2.2 Corrosion protection shall be applied in accordance with the design specification.

3.4.3 New and used components

3.4.3.1 It is permissible for wheelsets to be assembled with used components or a combination of new and used components that comply with their original design.

3.4.3.2 Specific requirements for branding of wheelsets and wheelset components are set out in 3.6 of this document.

3.4.4 Tyre security (shrink fit)

3.4.4.1 Tyres shall be fitted to wheel centres to ensure security throughout the wheelsets’ service life.

3.4.4.2 Tyre installations using retaining rings shall use only single piece ring, make up pieces are not permitted.

3.5 Wheelset testing

3.5.1 Wheelset NDT

3.5.1.1 Axles of assembled wheelsets shall comply with the appropriate NDT acceptance criteria defined by the design, see 2.2.

3.5.2 Wheelset electrical continuity

3.5.2.1 The wheelset shall be tested to comply with the requirements of the respective standard.
3.5.3 Wheelset balancing

3.5.3.1 Wheelsets shall be balanced in accordance with the requirements of the respective standard; BS 5892 Part 6 or BS EN 13260 or AAR Manual of Standards and Recommended Practices Section G - Part II.

3.5.3.2 Wheelsets that operate at speeds in excess of 125 mile/h and up to 140 mile/h shall have wheelset out of balance less than 50 gram.metres.

3.5.3.3 Wheelsets that physically cannot be dynamically balanced, typically due to axle mounted drives, shall be shown to have the equivalent imbalance within the permitted tolerance by calculation. The tread run-out for wheelsets that cannot be physically balanced shall be minimised.

3.6 Wheelset identification

3.6.1 Branding

3.6.1.1 All wheelsets and components of wheelsets shall be branded in accordance with the respective requirements of:
   a) Appendix B of this document
   or
   b) BS EN 13260, BS EN 13261 and BS EN 13262
   or

3.6.1.2 Wheelsets shall not have labels or bands attached as a means of identification as an alternative to branding; the arrangements contained in UIC 813, clause 4.2.5.2, paragraph 2 are not permitted.

3.6.1.3 Any markings on re-used components which refer to the original wheelset shall be erased and the wheelset records endorsed. Illegible or obscured brandings shall be erased and the component shall be re-branded according to the requirements of this document.

3.6.2 Unique identification of axles

3.6.2.1 Each new axle shall be branded with a unique serial number, allocated from the wheelset assembler’s own series of numbers. Axles shall not be given the number of:
   a) An axle it replaces
   b) A previously scrapped axle.

3.6.2.2 Particular attention shall be given to the inclusion of the wheelset assembler’s code.

3.6.3 General stamping requirements

3.6.3.1 Wheelset branding shall be in accordance with the appropriate standard, cold stamping is the preferred method.

3.6.3.2 The stamping shall not create stress raising features in the component, such as sharp corners or notches. Stamps shall be of a rounded profile that does not produce sharp indentations in the wheelset components. In avoiding stress raising features the fully worn wheel condition shall be considered. The branding shall in no circumstance create a notch in the chamfer at the edge of the tread profile.
3.6.3.3 Automated processes shall be assessed for their suitability of marking wheelset components to meet the requirements of 3.6.3.2 of this document.

3.6.3.4 The branding shall be of a size and depth such that the information is clearly legible when the appropriate surface coating or protection is applied at any stage of the wheelset life.

3.7 Corrosion protection
3.7.1 After completion of all tests on the wheelset, the corrosion protection shall be completed or applied, as required by the design specification.

3.7.2 Overhangs and other moisture traps at the axle to wheel interface and similar locations shall be treated in accordance with the design specification.

3.8 Handling and care of wheelsets
3.8.1 Wheelsets which are not in service under vehicles and wheelset components prior to assembly shall be protected, stored, handled and transported in a manner which is not detrimental to the wheelset / component life. Guidance is set out in GM/GN2498.

3.9 Records to ensure traceability
3.9.1 Records shall be maintained so that wheelsets, axles, monobloc wheels, wheel centres and tyres are identified against one wheelset manufacturer, casting batch and year of manufacture. These records shall include: cast number and manufacturer’s code, and year of both component manufacture and wheelset assembly.

3.9.2 A list of the suppliers and their branding codes is published on the RSSB website.

3.10 Qualification of wheelset suppliers
3.10.1 GM/RT2470 sets out the arrangements for qualification of suppliers of railway wheelsets, component manufacturers and wheelset assemblers.
Part 4 Requirements for Maintenance

4.1 Maintenance plan
4.1.1 All wheelsets shall remain compliant with the requirements, including limits, set out in this document. This shall be achieved through examinations in accordance with a wheelset maintenance plan.

4.1.2 The maintenance plan shall identify all specifications, procedures and processes, including examination, inspection and testing, for wheelset maintenance, which shall be applied at a frequency adequate to ensure that the wheelset is at all times in a compliant condition.

4.1.3 GM/RC2496 provides recommendations for wheelset maintenance, in particular requirement for applications in the UK.

4.2 Handling and care of wheelsets
4.2.1 The requirements for handling and care of wheelsets are set out in 3.8 of this document.

4.3 Corrosion protection
4.3.1 After testing the axle and wheelset, corrosion protection shall be reinstated, to the requirements set out in 3.7 of this document.

4.4 Wheelset tread profile requirements
4.4.1 The tread, when newly profiled, shall be as defined by the design for the wheelset / vehicle combination and selected only from those listed in Appendix A and applied to each wheel of a wheelset.

4.4.2 The tread, when newly profiled, shall comply with the requirements set out in the respective standard, BS 5892, Parts 3 and 6, EN13260 and AAR Manual of Standards and Recommended Practices.

4.5 Maximum force
4.5.1 Where it is established, for example by wheel impact load detection equipment, that any defect in a wheel contributes to producing a total vertical force of more than 350 kN per wheel, the wheelset shall be examined.

4.6 Tread requirements
4.6.1 Flats damage requirements
4.6.1.1 Where wheel flats are found, the length of the flat around the circumference of the wheel shall be measured to the outer edge of any discolouration or of the worn / damaged area, whichever is the greater. Action for a measured flat shall be taken as set out in Table 2.
### Table 2  Wheel flat criteria

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Wheel flat length</th>
<th>Vehicle to be removed from service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any vehicle permitted to operate above 125 mile/h and up to 140 mile/h</td>
<td>Above 60 mm</td>
<td>Immediately</td>
</tr>
<tr>
<td></td>
<td>Above 40 mm to</td>
<td>On completion of the journey. The speed shall be limited to 125 mile/h until the vehicle is</td>
</tr>
<tr>
<td></td>
<td>60 mm</td>
<td>taken out of service</td>
</tr>
<tr>
<td></td>
<td>30 to 40 mm</td>
<td>Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Passenger or personnel vehicles operating at speeds up to and including</td>
<td>Above 60 mm</td>
<td>Immediately</td>
</tr>
<tr>
<td>125 mile/h</td>
<td>40 to 60 mm</td>
<td>Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Non-passenger vehicles, locomotives, power cars, driving van trailers, on-track machines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Above 60 mm</td>
<td>Immediately</td>
</tr>
<tr>
<td></td>
<td>40 to 60 mm</td>
<td>On completion of the journey</td>
</tr>
<tr>
<td>Freight vehicles up to 17.5 tonnes axle load</td>
<td>Above 80 mm</td>
<td>Immediately</td>
</tr>
<tr>
<td></td>
<td>60 to 80 mm</td>
<td>On completion of the journey. The speed to be restricted to 60 mile/h</td>
</tr>
<tr>
<td>Freight vehicles equal to or over 17.5 tonnes axle load</td>
<td>Above 70 mm</td>
<td>Immediately</td>
</tr>
<tr>
<td></td>
<td>50 to 70 mm</td>
<td>On completion of the journey. The speed to be restricted to 60 mile/h</td>
</tr>
<tr>
<td>Other vehicles</td>
<td>Above 60 mm</td>
<td>Immediately</td>
</tr>
<tr>
<td></td>
<td>40 to 60 mm</td>
<td>On completion of the journey. The speed to be restricted to 60 mile/h</td>
</tr>
</tbody>
</table>

4.6.1.2 For wheels smaller than 660 mm, the small wheel criteria set out in RIS-1530-PLT shall apply.
4.6.2 Tread run-out

4.6.2.1 Where the presence of tread run-out is established, by measurement (see Figure 3 dimension H), action shall be taken as set out in Table 3.

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Tread run-out</th>
<th>Vehicle to be removed from service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any vehicle permitted to operate above 125 mile/h and up to 140 mile/h</td>
<td>Above 1.3 mm, 0.7 mm to 1.3 mm</td>
<td>Immediately, Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Passenger or personnel vehicles operating at speeds up to and including 125 mile/h</td>
<td>Above 3.0 mm, 1.3 mm to 3.0 mm</td>
<td>Immediately, Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Non-passenger vehicles, locomotives, power cars, driving van trailers and on-track machines</td>
<td>Above 3.0 mm, 1.3 mm to 3.0 mm</td>
<td>Immediately, On completion of the journey</td>
</tr>
<tr>
<td>Freight vehicles up to 17.5 tonnes axle load</td>
<td>Above 5.0 mm, 3.0 mm to 5.0 mm</td>
<td>Immediately, On completion of the journey, The speed to be restricted to 60 mile/h</td>
</tr>
<tr>
<td>Freight vehicles equal to or over 17.5 tonnes axle load</td>
<td>Above 4.0 mm, 2.0 mm to 4.0 mm</td>
<td>Immediately, On completion of the journey, The speed to be restricted to 60 mile/h</td>
</tr>
<tr>
<td>Other vehicles</td>
<td>Above 4.0 mm, 2.0 mm to 4.0 mm</td>
<td>Immediately, On completion of the journey, The speed to be restricted to 60 mile/h</td>
</tr>
</tbody>
</table>

Table 3 Tread run-out criteria
4.6.3 Permitted speed for recovery of vehicles with flats or tread run-out
4.6.3.1 When flats, or tread run-out are found, and in order to move the vehicle to where
the defect can be rectified, the requirements set out in Table 4 shall be applied.

<table>
<thead>
<tr>
<th>Damage</th>
<th>Speed restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat length longer than 100 mm or Tread run-out greater than 8.0 mm</td>
<td>A vehicle shall not be moved except to clear the running line and at a maximum speed of 5 mile/h or with the use of a wheelskate. Further movement shall be with the authorisation of a technically competent authority and the infrastructure manager.</td>
</tr>
<tr>
<td>Flat length 70 mm to 100 mm long or Tread run-out 5.0 mm to 8.0 mm</td>
<td>Speed restriction of 35 mile/h</td>
</tr>
<tr>
<td>Flat length up to 70 mm long or Tread run-out 3.0 mm to 5.0 mm</td>
<td>Speed restriction of 60 mile/h</td>
</tr>
</tbody>
</table>

Table 4  Speed limits for recovery of vehicles with wheel flats

4.7 Profile discontinuities
4.7.1 There shall be no wear or damage of the profile which creates discontinuities in the profile shape of the tread or the flange. There shall be no circumferential step in the flange profile greater than 1.5 mm (see Figure 5). A wheelset with such features shall be removed from service within 24 hours of the fault being found.

4.8 Inspection after identification of wheel flat and tread run-out
4.8.1 Tread damage in excess of the criteria requiring immediate wheelset removal from service, as set out in 4.6 and 4.7 of this document, can be the cause of underlying damage to the wheelset and other parts of the vehicle, including bearings, suspension, etc. The railway undertaking shall ensure that all tread damage is rectified by re-profiling and that the wheelset and associated suspension components remain serviceable.

4.9 Flange requirements
4.9.1 Minimum flange radius
4.9.1.1 The flange tip shall not wear to form either a sharp flange or toe radius build-up (see Figures 5 and 6), as gauged in accordance with the guidance set out in GM/GN2497. A wheel flange failing these criteria shall be withdrawn from service within 24 hours of the fault being found.

4.9.2 Flange back
4.9.2.1 No point in the flange back blend shall be closer to the vehicle centre-line than the flange back, refer to Figure 4.

4.9.3 False flange
4.9.3.1 A false flange (see Figure 7) shall not exceed 2.0 mm.
4.10 Advice of wheel damage to the infrastructure manager

4.10.1 The railway undertaking shall advise the infrastructure manager of wheelset damage that may have adversely affected the track over which it has been operating. These are to include wheelsets that have been removed from service for:

a) Wheel flats that exceed criteria for vehicle to be removed from service, as set out in 4.6 of this document.

b) Tread run-out that exceed criteria as set out in 4.6 of this document.

c) False flange exceeding the limits defined in 4.9.3.1 of this document.

4.10.2 The railway undertaking shall identify the vehicle, the train formation it had been operating within and the routes on which it had been operating prior to being removed from service.

4.11 Profile limits

4.11.1 Dimensional limits

4.11.1 Railway undertakings shall establish dimensional limits to ensure that the safety limits set out in Appendix A of this document are not infringed between examinations. The limits shall include the minimum rim and tyre thickness. Railway undertakings shall ensure that the required dimensions and tolerances are specified for each wheelset / vehicle combination and that these dimensions are recorded in the wheelset database.

4.12 Tread roll-over and rim face bulging

4.12.1 Up to 5 mm of roll-over is allowed in-service provided no cracks in the roll-over shall extend into the tread or the rim face (see Figure 8).

4.12.2 In-service local tread collapse in the form of a rim face bulge in excess of 2 mm (see Figure 9) is not permitted and such a feature shall cause the wheelset to be removed from service within 24 hours of the fault being identified.

4.13 Monitoring and recording of cracks

4.13.2.1 The maximum length of multiple or isolated cracks in wheel tread or web shall be assessed by measurement and recorded. Limits for permissible cracks shall be set out in the appropriate maintenance procedure for the specific wheelset design / vehicle application and, where required shall not exceed those specified in 4.14 of this document.

4.14 Limits for permissible cracks

4.14.1 Wheelsets designed and manufactured to BASS design codes

4.14.1.1 The maintenance criteria included in 4.14.2, 4.14.3 and 4.14.4 are derived from the safe operating experience of wheelsets designed and manufactured to the British Rail (BR) bogie and suspension section (BASS) design codes and associated British Standards that operated on the BR network.

4.14.2 Cracks in the wheel tread, rim or flange

4.14.2.1 Where cracks are found in the transition between tread and rim, on the outside face of the rim, in the flange or in any roll-over (see Figures 8 and 10), then the wheelset shall be removed from service immediately. Any move to a repair facility shall be at a speed restricted to 45 mile/h or less.
4.14.3 Multiple cracks on the tread
4.14.3.1 Where multiple small cracks are found in the tread and one of the cracks exceeds 40 mm in length the wheelset shall be removed from service within 24 hours of the fault being identified.

4.14.4 Isolated cracks on the tread
4.14.4.1 Where an isolated crack longer than 30 mm is found in the tread, the vehicle shall be removed from service immediately. Where an isolated crack longer than 20 mm is found in the tread, the wheelset shall be removed from service within 24 hours of the fault being found.

4.14.5 Wheelsets designed and manufactured to other design codes
4.14.5.1 No limits for permissible cracks are set for wheelsets designed and manufactured to design codes other than BASS design codes. Limits shall be derived by comparison with the limits set for wheelsets designed to BASS design codes, taking into account the specific characteristics of the wheelset concerned.

4.15 Tread cavities
4.15.1 The wheelset shall be removed from service within 24 hours of either of the following faults being found:
   a) Any single cavity greater than 15 mm long circumferentially around the wheel
   b) Any two cavities, separated by less than 50 mm, having a total length in excess of 15 mm circumferentially around the wheel.

4.16 Back-to-back dimension
4.16.1 The back-to-back dimension shall be within the range set out in Table 5.

<table>
<thead>
<tr>
<th>Wheelset type</th>
<th>Dimension range</th>
</tr>
</thead>
<tbody>
<tr>
<td>All new, re-wheeled or re-tyred wheelsets with outside bearings</td>
<td>1360 to 1362 mm</td>
</tr>
<tr>
<td>Re-profiled and in-service wheelsets with outside bearings</td>
<td>1360 to 1363.3 mm</td>
</tr>
<tr>
<td>Any wheelset with inside bearings</td>
<td>1358 to 1360 mm</td>
</tr>
<tr>
<td>Class 373 (Eurostar)</td>
<td>1357 to 1363 mm</td>
</tr>
<tr>
<td>Steam locomotive</td>
<td>1360 to 1362 mm</td>
</tr>
</tbody>
</table>

Table 5 Wheelset back-to-back dimensions

4.17 Diameter difference between wheels on the same axle
4.17.1 The maximum variation between wheel diameters following profiling for wheels on the same axle shall be in accordance with the requirements of BS 5892, Part 6, Table 2 or BS EN 13260, Table 3. Figures 1 and 2 L – L₁ indicate the measurement position.


4.18 Limits for tread run-out and wheel wobble

4.18.1 When new, or following re-wheeling or re-tyring, the tread run-out and the wheel wobble (see Figure 2, dimension H, and Figure 2, dimension G, respectively) shall not exceed the values set out in Table 6.

<table>
<thead>
<tr>
<th>Maximum tread run-out (mm)</th>
<th>Maximum wheel wobble (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All vehicles permitted to operate at speeds greater than 125 mile/h and up to and including 140 mile/h</td>
<td>0.20</td>
</tr>
<tr>
<td>Locomotives and coaching stock operating at speeds up to and including 125 mile/h</td>
<td>0.25</td>
</tr>
<tr>
<td>Freight vehicles operating at speeds greater than 75 mile/h and up to and including 100 mile/h</td>
<td>0.30</td>
</tr>
<tr>
<td>Freight vehicles operating at speeds between 60 and 75 mile/h</td>
<td>0.40</td>
</tr>
<tr>
<td>Freight vehicles operating at speeds up to and including 60 mile/h</td>
<td>0.50</td>
</tr>
<tr>
<td>All other vehicles</td>
<td>As BS 5892, Part 6</td>
</tr>
<tr>
<td>AAR wheelsets</td>
<td>New AAR wheelsets shall comply with the requirements in rules 1E12 and 1F4 of AAR Manual of Standards and Recommended Practices Section G – Part II.</td>
</tr>
</tbody>
</table>

Table 6 Tread run-out and wheel wobble limits

4.18.1a When a wheelset is re-profiled, the maximum tread run-out shall be as set out in Table 6. The maximum allowable wheel wobble shall not exceed 0.75 mm for all vehicles.

4.18.2 Resilient wheels when new, re-wheeled or re-tyred shall have a maximum wheel wobble of 0.75 mm for all vehicles.

4.18.3 Resilient wheels shall have a maximum wobble of 1 mm following re-profiling.

4.19 Wheel tread profile alignment and symmetry

4.19.1 When newly turned, the wheel tread profiles on each wheel shall be aligned with the wheelset axis.
4.19.2 Wheel tread profile shall be within a geometric tolerance of ± 0.25 mm of the nominal.

4.19.3 On new or overhauled wheelsets the outside face of the rim of the wheel or tyre shall be flat to within ± 0.25 mm.

4.20 Wheel centre to tyre integrity
4.20.1 The wheel centre to tyre interface shall be maintained to ensure integrity throughout its service life, with particular attention to the inspection and rectification of wheel centre interface surfaces.

4.21 Inner rim damage
4.21.1 Wheels shall be scrapped where damage on the inner surface of the rim exceeds 4 mm in depth. No damage with sharp, internal angles shall be permitted. It is permissible to grind out damage less than 4 mm deep by grinding 1 mm deeper than the damage and blending in the hollow over a length of five times the depth as shown in Figure 11. The rim shall then be proved to be defect-free by MPI, taking note of any machining processes that could mask any cracks.

4.22 Axle MPI inspection
4.22.1 Except for hollow axles subject to internal NDT inspection. Axles shall be subject to MPI or equivalent process during overhaul.

4.23 Balancing
4.23.1 Wheelsets shall be dynamically balanced to the design requirements when re-tyred, repaired or overhauled, when this is reasonably practicable.

4.24 Electrical testing
4.24.1 At overhaul the electrical resistance testing of wheelsets shall be undertaken.
Part 5  Safety at Obtuse Crossings

5.1  Low speed rule

5.1.1 Vehicles / wheelset arrangements shall comply with the ‘low speed rule’ set out in Appendix C of this document under all loading conditions. This rule covers the low speed operation over crossings on curves with applied lateral forces from external sources such as the wind and adversely canted track.
Part 6 Application of this document

6.1 Application - infrastructure managers
6.1.1 There are no requirements applicable to infrastructure managers.

6.2 Application - railway undertakings
6.2.1 Scope
6.2.1.1 The requirements of this document apply to all work associated with design, manufacture and maintenance of railway wheelsets.

6.2.2 Exclusions from scope
6.2.2.1 There are no exclusions from the scope specified in 6.2.1 for railway undertakings.

6.2.3 General compliance date for railway undertakings
6.2.3.1 This Railway Group Standard comes into force and is to be complied with from 03 April 2010, except as specified in 6.2.4. Where the dates specified in 6.2.4 are later than the above date, this is to allow railway undertakings sufficient time to achieve compliance with the specified exceptions.

6.2.3.2 After the compliance dates or the date by which compliance is achieved if earlier, railway undertakings are to maintain compliance with the requirements set out in this Railway Group Standard. Where it is considered not reasonably practicable to comply with the requirements, authorisation not to comply should be sought in accordance with the Railway Group Standards Code.

6.2.4 Exceptions to general compliance date
6.2.4.1 There are no exceptions to the general compliance date specified in 6.2.3 for railway undertakings.

6.3 Health and safety responsibilities
6.3.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.
Figure 1 Datum for measuring axle body run-out, tread run-out and wheel wobble
Railway Wheelsets

**Figure 2** Wheel wobble

**Figure 3** Wheel tread run-out
Note: refer to GM/RC2495 for permitted gap between the tyre snip end and the wheel centre, dimension X.

Figure 4 Diagrams identifying parts of the wheel
Figure 5 Step in flange and sharp flange

Figure 6 Toe radius build-up
This dimension is not to exceed 2.0 mm

**Figure 7** False flange

Tread rollover

**Figure 8** Wheel tread roll-over
Figure 9 Wheel rim distortion

Figure 10 Critical areas for cracks in wheel tread
Grind out defect and blend out as shown. Examine for cracks using magnetic particle flaw detection technique.

Depth of indentation $D\text{mm}$
Depth ground out $(D+1)\text{mm}$

Figure 11  Inner rim damage
Appendix A  Wheelset Profile Limits

The content of this appendix is mandatory

### A.1 Wheelset profile limits

A.1.1 The dimensions shown below are the limits of wheel tread wear.

A.1.1.2 The profiles for steam locomotives shall be defined by individual assessment, useful information is contained in MT276.

A.1.1.3 The flange height and thickness dimensions shown in Table A.1 have been rounded from the dimensions derived from the profile drawings; where greater accuracy is required the dimensions and tolerances on the drawings shall be used.

<table>
<thead>
<tr>
<th>Tread profile</th>
<th>Drawing number / specification</th>
<th>Flange thickness details (mm) (see note 1)</th>
<th>Flange height details (mm) (see note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>As new (W)</td>
<td>Minimum (worn) (X)</td>
</tr>
<tr>
<td>P1</td>
<td>S8 C2-8006234</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>P5</td>
<td>S8-C2-8003908</td>
<td>31.5</td>
<td>27</td>
</tr>
<tr>
<td>P6</td>
<td>S8-C2-8006238</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td>P8</td>
<td>S8-C2-8006239</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td>P9 (see note 2)</td>
<td>S8-C2-8006240  (21.5)</td>
<td>25</td>
<td>21 (18)</td>
</tr>
<tr>
<td>P10</td>
<td>F-C-00234</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td>P11</td>
<td>C1-C1-9016365</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>RD9</td>
<td>A1-C1 8700150</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>P12 (formerly WRISA 2)</td>
<td>RV-CO-2400412</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td>Eurostar (see note 3)</td>
<td>NF.F01-115 (1/40 profile and 135 mm rim)</td>
<td>32.5</td>
<td>26</td>
</tr>
<tr>
<td>S1002</td>
<td>BS EN 13715:2006</td>
<td>31</td>
<td>24</td>
</tr>
<tr>
<td>EPS (see note 4)</td>
<td>BS EN 13715:2006</td>
<td>28</td>
<td>24</td>
</tr>
</tbody>
</table>

Table A.1  Flange height and thickness by tread profile

Note 1: For datum points at which flange thickness and height are measured (see Figures A.1 and A.2).

Note 2: The dimensions in brackets are applicable if the Datum Face V of the tread profile is used for measurements (see Figures A.1 and A.2).

Note 3: For the Eurostar (NF.F01-115) profile the dimension 13 mm in Figures A.1 and A.2 is reduced to 10 mm.

Note 4: The limits specified for the EPS profile are consistent with those defined for the safe operation of the P8 profile.
Note 5: Copies of the tread profile drawings can be obtained from:

Document Services Team
Serco Assurance – Raildata
East Wing Ground Floor
Derwent House
rtc Business Park
London Rd
Derby
DE24 8UP
Tel: 01332 262443

Figure A.1  Flange height and thickness - new

Key

\( W \) = Flange thickness (new)
\( Y \) = Flange height (new)
\( A \) = Flange thickness datum - 13 mm for UK profiles
- 10 mm for EN profiles
Figure A.2  Flange height and thickness - worn

Key

X = Flange thickness (worn)
Z = Flange height (worn)
A = Flange thickness datum - 13 mm for UK profiles
     - 10 mm for EN profiles
Appendix B  Branding

The content of this appendix is mandatory when complying with 3.6.1.1 a)

B.1  Axle branding

B.1.1  Forged axle identification

B.1.1.1  Axles in the as forged or rough machined condition shall be branded, as set out in Figure B.1. The stamping shall be at one end only and shall be light but legible.

B.1.2  Axle end branding

B.1.2.1  Before the wheel seat is finish machined the markings, except for the inspector's stamp, shall be recorded for inclusion in the records associated with the finished axle. The branding shall be applied by cold stamping at one end only as soon as the areas to be stamped have been finish machined in the positions shown by:

  a)  Roller bearing axle, as shown in Figure B.2
  b)  Plain bearing axle, as shown in Figure B.3
  c)  Roller bearing axle with thrust pads, as shown in Figure B.4
  d)  Plain bearing axle with thrust pads, as shown in Figure B.5.

B.1.2.2  The branding shall be applied at the gear wheel end of a driven axle.

B.1.2.3  Axles supplied in the finish machined condition shall have the brandings as required in B.1.1.1 and Figure B.1 stamped onto the axle end. This branding shall be identified by the use of ‘&’ either side of the additional information, for example ‘& SP 95 SC5761 &’.

B.1.3  Axle end additional branding

B.1.3.1  Assembled axles shall have the axle end additionally branded as shown in:

  a)  Figure B.4 for roller bearing axles
  b)  Figure B.5 for plain bearing axles.

B.1.3.2  The branding shall be dressed to remove any raised burrs. For hollow axles, where the end cap is not removed for ultrasonic inspection of the axle, it is permissible to etch additional branding inside in the bore.

B.2  Monobloc wheelset branding

B.2.1  Monobloc branding

B.2.1.1  Monobloc wheels shall be branded by stamping during manufacture, as shown in Figure B.6, wheel rims that have been ultrasonically tested shall include "UT" in the branding. The cast identity shall be stamped. Where practicable the oil injection plug shall be machined on the same radial line as the branding.

B.2.2  Monobloc wheelset branding

B.2.2.1  When assembled onto an axle, both monobloc wheels shall be branded on the inside face of the wheel, as shown in Figure B.7. Where inside face branding is not practicable, because of the proximity of a gear wheel for example, then it is permissible to stamp on the outside of the wheel only, at the same radial and circumferential location. The branding shall be diametrically opposite the branding on the rim applied during manufacture.
B.3 Tyred wheelset branding

B.3.1 Wheel centre branding

B.3.1.1 Wheel centres shall be branded during manufacture, as shown in Figure B.9. When machined, the oil injection plug shall be located diametrically opposite the branding.

B.3.2 Tyre branding

B.3.2.1 Tyres shall be branded during manufacture, as shown in Figure B.9. The branding shall be below any last turning groove which may be present and shall not intrude into the chamfer machined at the edge of the wheel tread. The edge of the wheel tread shall not contain any notches or other stress raising features.

B.3.3 Assembled tyre branding

B.3.3.1 When a tyre is fitted to a wheel centre the additional information, as shown in Figure B.10 (items 12, 11 and 5) shall be cold stamped onto the tyre in the position shown.

B.3.4 Tyred wheelset branding

B.3.4.1 When assembled onto an axle, both tyred wheels shall be additionally branded on the inside face of the wheels, as shown in Figure B.10. Where inside face branding is not practicable, because of the proximity of a gear wheel for example, it is permissible to brand the outside face adjacent to the brands applied during manufacture. The branding shall be diametrically opposite the branding on the tyre.

B.3.5 Material grades

B.3.5.1 The grade of material codes set out in Table B.1 shall be used when branding wheels, wheel centres and tyres. The branding requirements are as set out in this document.
### Grade of material

<table>
<thead>
<tr>
<th>Grade of material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.R. SPEC. 107</td>
<td>A</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108B</td>
<td>B</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108C</td>
<td>C</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108D</td>
<td>D</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108E</td>
<td>E</td>
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<tr>
<td>B.R. SPEC. 167(C52TS)</td>
<td>F</td>
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<td>B.R. SPEC. 118A</td>
<td>H</td>
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<td>Grade B5</td>
</tr>
<tr>
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<td>5</td>
</tr>
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<td>U.I.C. 810-1</td>
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</tr>
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<td>B.S. 5892 Pt 3</td>
<td>Grade R7E</td>
</tr>
<tr>
<td>I.S.O. 1005 Pt 6</td>
<td>7E</td>
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<tr>
<td>U.I.C. 810-3</td>
<td>Grade R7T</td>
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<tr>
<td>I.S.O. 1005 Pt 6</td>
<td>7T</td>
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<tr>
<td>U.I.C. 810-3</td>
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<tr>
<td>B.S. 5892 Pt 2</td>
<td>Untreated</td>
</tr>
<tr>
<td>I.S.O. 1005 Pt 6</td>
<td>8E</td>
</tr>
<tr>
<td>U.I.C. 810-3</td>
<td>Normalised</td>
</tr>
<tr>
<td></td>
<td>8T</td>
</tr>
<tr>
<td></td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
</tbody>
</table>

**Table B.1** Wheelset unique identification codes

**B.3.5.2** At overhaul and re-assembly of wheelsets:

a) The axle serial number shall be checked to establish that it is not duplicated

b) The branding shall conform to the requirements of this document.

**B.3.5.3** Where the number is not unique, has no assembler's code or is in any way deficient, railway undertakings shall require the latest assembler to allocate an axle serial number from its own number series. The number shall be branded on the axle according to the requirements of this document. The wheelset records shall be endorsed, recording both the new serial number and the replaced serial number.

**B.3.6** Removal of branding codes

**B.3.6.1** When it is necessary to erase the existing branding on a wheel, the marks shall be peened out and erased by filing. The new or reinstated data shall be cold stamped in the relevant location, as required by this document.
B.3.7 Assembler's identification

B.3.7.1 When the wheelset is repaired or overhauled by a different contractor from the original assembling contractor, then on re-assembly the latest assembler's code shall be stamped on the axle end, see Figures B.4 and B.5, or stamped to comply with AAR requirements, as appropriate.

B.3.8 Wheel branding

B.3.8.1 On re-assembly the monobloc wheels shall be branded in accordance with one of the following: as set out in B.3.5 or UIC or AAR requirements, as appropriate, and tyred wheels shall be branded, as set out in B.3.6 or UIC requirements. The latest assembler's code shall be added where the wheel is not new and where the wheelset has been repaired or overhauled by a different contractor from the original assembler.

B.3.9 New tyre branding

B.3.9.1 When a wheel centre is re-tyred the new tyre shall have the branding completed as is shown in Figure B.10 (items 11, 12 and 5), or as set out in UIC requirements.

B.3.10 Axle geometry codes

B.3.10.1 The axle geometry codes set out in Table B.2 shall be included in the axle branding for the following axles:

<table>
<thead>
<tr>
<th>Code</th>
<th>Reclaimed axle geometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Re-profiled</td>
</tr>
<tr>
<td>G</td>
<td>Stress relieving grooves added</td>
</tr>
<tr>
<td>G1</td>
<td>25 mm (1 inch) stress relieving grooves added</td>
</tr>
<tr>
<td>WG</td>
<td>Wide stress relieving grooves added</td>
</tr>
</tbody>
</table>

Table B.2 Axle geometry codes
Railway Wheelsets

Figure B.1  As forged condition axle markings

Figure B.2  Branding on finish machined roller bearing axles
Figure B.3  Branding on finish machined plain bearing axle

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Axle serial number (from assembling contractor's number allocation).</td>
</tr>
<tr>
<td>8</td>
<td>Axle geometry code, if applicable, to be cold stamped after the serial number.</td>
</tr>
</tbody>
</table>
Railway Wheelsets

Figure B.4 Axle end branding of roller bearing axles

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Inspector’s stamp (optional).</td>
</tr>
<tr>
<td>7</td>
<td>Axle serial number (from assembling contractor’s number allocation).</td>
</tr>
<tr>
<td>8</td>
<td>Axle geometry code, if applicable, to be cold stamped after the serial number.</td>
</tr>
<tr>
<td>9</td>
<td>Original assembling contractor’s code.</td>
</tr>
<tr>
<td>12</td>
<td>Latest subsequent assembling contractor’s code. To be used when a wheelset has been repaired or overhauled by a different contractor from the original assembling contractor.</td>
</tr>
</tbody>
</table>
Figure B.5 Axle end branding of plain bearing axles

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Inspector’s stamp (optional).</td>
</tr>
<tr>
<td>7</td>
<td>Axle serial number (from assembling contractor’s number allocation).</td>
</tr>
<tr>
<td>8</td>
<td>Axle geometry code, if applicable, to be cold stamped after the serial number.</td>
</tr>
<tr>
<td>9</td>
<td>Original assembling contractor’s code.</td>
</tr>
<tr>
<td>12</td>
<td>Latest subsequent assembling contractor’s code. To be used when a wheelset has been repaired or overhauled by a different contractor from the original assembling contractor.</td>
</tr>
</tbody>
</table>
1 Grade of material.
2 Manufacturing contractor’s code.
3 Year of manufacture.
4 Cast identity.
5 Inspector’s stamp (optional).
13 Ultrasonic code, wheel rims that have been ultrasonically tested shall be stamped UT.

Figure B.6  Branding on monobloc wheels during manufacture
5 Inspector’s stamp (optional).

7 Axle serial number (from assembling contractor’s number allocation).

8 Axle geometry code, if applicable, to be cold stamped after the serial number.

9 Original assembling contractor’s code.

10 Tyre profile.

11 Date of assembly of wheelset.

12 Latest subsequent assembling contractor’s code. To be used when a wheelset has been repaired by a different contractor from the original assembling contractor.

Figure B.7 Branding on monobloc wheels after assembly
Figure B.8 Branding on wheel centre during manufacture
**Figure B.9** Branding on tyres during manufacture

1. Grade of material.
2. Manufacturing contractor’s code.
3. Year of manufacture.
5. Inspector’s stamp (optional).
Railway Wheelsets

Figure B.10 Branding on tyres and wheels following assembly
Appendix C  Safety at Obtuse Crossings

The content of this appendix is mandatory

Note: Where the diameter of a wheel, when fully worn, is 660 mm or greater, and the chosen tread profile is in accordance with Appendix 3, it is permissible to assume that this rule is satisfied.

C.1 Low speed rule

C.1.1 To ensure the safe operation of wheelsets through obtuse crossings the 'low speed rule' shall be satisfied. The derailment risk is assessed by the wheelset lateral displacement when passing through a crossing gap. Too much will result in contact with the tip of the point rail (L₂ in Figure Appendix C.1) on a part of the flange where there may be insufficient contact angle to ensure guidance into the correct path. The acceptable magnitude of the sideways displacement for a given wheel profile is defined, at low speed, on the basis that the flange contact angle is greater than 45°.

C.1.2 The 'low speed rule' requires that the following inequality shall be met:

\[ L_{uc} \Psi_o + \Delta_{slip} + 5 L_{ug} < \Delta_{crit} \]  \hspace{1cm} \text{formula (1)}

where:

- \( L_{uc} \) is the unchecked length  \( \text{m} \)
- \( \Psi_o \) is the steady-state angle of attack  \( \text{mm} \)
- \( \Delta_{slip} \) is the lateral slip distance  \( \text{mm} \)
- \( L_{ug} \) is the unguided length  \( \text{m} \)
- \( \Delta_{crit} \) is the allowable sideslip  \( \text{mm} \)

C.1.3 The most critical of these terms is the lateral slip distance. The vehicle types most at risk are two axled high-sided vehicles with low axle loads.

C.1.4 Two cases of wind loading and track cant shall be considered:

a) A wind speed of 25 m/s and zero track cant

b) A wind speed of 17.5 m/s combined with an adverse track cant of 3°.

C.1.5 The resultant external lateral force on the vehicles is then given by the greater of:

\[ F_{ext} = 0.46 A_w \]  \hspace{1cm} \text{formula (2)}

or

\[ F_{ext} = 0.23 A_w + 0.05 W \]

where:

- \( A_w \) is the area exposed to the wind  \( \text{m}^2 \)
- \( W \) is the total vehicle weight  \( \text{kN} \)
- \( F_{ext} \) is the resultant lateral body force  \( \text{kN} \)

C.1.6 Compliance with the inequality (1) shall be at the crossing angles identified in Table C.1.
C.1.7 The procedure for applying formula (1) is as follows:

a) Determine the value of $\Delta_{\text{crit}}$, the maximum permissible sideways displacement in the gap for the wheel profile chosen, refer to Figure C.2.

b) Choose the crossing angle to be considered.

c) Determine the unchecked length $L_{uc}$ for the crossing angle being considered, refer to Table C.1.

d) Determine the unguided length $L_{ug}$ for the crossing angle and wheel diameter being considered, refer to Figure C.3.

e) Determine the minimum curve radius $R_{\text{min}}$ for the crossing angle being considered, refer to Table C.1.

f) Determine the steady state angle of attack of the leading wheelset, assuming the vehicles to be running on a constant curve of radius equal to the minimum permissible radius for the crossing angle being considered. Assume a wheel / rail friction coefficient of 0.1, a track gauge of 1438 mm (nominal gauge plus 6 mm maintenance allowance) and full allowable wheel flange wear. Add to this calculated angle of attack value an allowance for the permissible wheelset yaw misalignment tolerance in the vehicle to give the $\Psi_o$ value to substitute in formula (1). In determining the steady state angles of attack of the wheelsets, the external lateral forces on the vehicles should be neglected.

g) Superimpose on the steady state curving situation in f), above, an external force applied to the vehicle body of $F_{\text{ext}}$ as determined by formula (2). Calculate the value of $\Delta_{\text{slip}}$ for the leading wheelset which would occur if its flange force were suddenly removed, assuming a wheel / rail friction coefficient of 0.1.

h) Check that the inequality of formula (1) is satisfied.

i) Repeat b) to h) for the remaining crossing angles.

C.1.8 The vehicle design shall minimise the generation of lateral loads by buffers and drawgear and by other inter-vehicle constraints. The possibility of braking systems causing wheel locking is be minimised to avoid the occurrence of exceptionally low lateral adhesion levels.

C.1.9 The vehicle design shall minimise the generation of lateral loads

<table>
<thead>
<tr>
<th>Crossing angle (1 in N)</th>
<th>Gap (67 N) mm</th>
<th>Stagger (1391/2 N) mm</th>
<th>Unchecked length $L_{uc}$ m</th>
<th>Minimum curve radius $R_{\text{min}}$ m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 8.0</td>
<td>536</td>
<td>87</td>
<td>0.449</td>
<td>500</td>
</tr>
<tr>
<td>1 in 7.5</td>
<td>502</td>
<td>93</td>
<td>0.409</td>
<td>400</td>
</tr>
<tr>
<td>1 in 6.5</td>
<td>433</td>
<td>107</td>
<td>0.326</td>
<td>240</td>
</tr>
<tr>
<td>1 in 5.5</td>
<td>371</td>
<td>126</td>
<td>0.245</td>
<td>160</td>
</tr>
</tbody>
</table>

Table C.1 Obtuse crossing data
Nominal gauge | 1435 mm
Nominal check gauge | 1391 mm
Nominal flange way | 41 mm

Figure C.1 Obtuse crossing layout

Figure C.2 Definition of $\Delta_{\text{crit}}$
Railway Wheelsets

Figure C.3 Unguided length (as a function of wheel diameter and crossing angle)
Appendix D  Quenched and Tempered Monobloc Wheels
Manufactured to UIC 812-3 (withdrawn)

The content of this appendix is mandatory when complying with 2.9.3.

D.1 Quenched and tempered monobloc wheels, condition E
D.1.1 General manufacturing requirements
D.1.1.1 Monobloc wheels manufactured by the quenched and tempered heat treatment process in accordance with UIC 812-3 (withdrawn) shall comply with the requirements of BS EN 13262, except for the specific requirements set out in Appendix D.

D.1.2 Chemical composition
D.1.2.1 The chemical composition shall be in accordance with the requirements set out in BS EN 13262.

D.1.3 Heat treatment – quench and temper (UIC 812-3 clause 4.2)
D.1.3.1 Heat treatment by immersion quench and temper, condition E, shall be understood to mean heating the wheel for sufficient time to bring it uniformly to a temperature exceeding the transformation temperature of the grade of steel by about 25ºC, cooling by immersion quenching in a bath containing suitable liquid, followed by tempering at a minimum temperature of 500ºC. The wheel is then left to cool in still air.

D.1.4 Mechanical properties (UIC 812-3 clause 7.7.3.2)
D.1.4.1 The rim characteristics are set out in Table D.1.

D.1.5 Rim hardness characteristic (UIC 812-3 clauses 5.2.4 & 5.2.5)
D.1.5.1 The minimum Brinell hardness values applicable to the whole wear zone of the rim shall be equal or greater than the values set out in Table D.1.

D.1.5.2 The measurement of hardness at rim-web transition is not applicable to wheels heat treated to condition E.

D.1.6 Residual stress (UIC 812-3 clause 5.2.6)
D.1.6.1 The assessment of residual stress is not applicable for monobloc wheels heat treated to condition E.

<table>
<thead>
<tr>
<th>Equivalent Steel grade</th>
<th>Minimum Brinell hardness value</th>
<th>Minimum impact test values</th>
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</thead>
<tbody>
<tr>
<td>UIC 812-3</td>
<td>EN 13262</td>
<td>KU (Joules)</td>
</tr>
<tr>
<td>R6</td>
<td>ER6</td>
<td>217</td>
</tr>
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<td>R7</td>
<td>ER7</td>
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<td>ER8</td>
<td>241</td>
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<td>R9</td>
<td>ER9</td>
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Table D.1  Condition E hardness and impact characteristics
Railway Wheelsets

Definitions

AAR
Association of American Railroads.

Axlebox
The structure, including cartridge bearing adaptor, which houses, or is in contact with, the axle journal bearing and provides an interface with the bogie and / or suspension arrangement.

Axle run-out
The total radial displacement measured at the centre of the axle when it is rotated on rollers supporting the wheelset bearing journals.

Cold stamping
Alpha-numeric stamping performed on the component whilst it is at ambient temperature.

Defect
Any fault(s) in a component, or assembly, which may prevent the component, or assembly, from fulfilling its design purpose.

Design life
The total time or distance over which a wheelset is intended to provide a defined standard of performance while subject to a pre-defined regime of maintenance, repair and overhaul.

Freight vehicle
Vehicles designed and used for carrying payloads which do not include people.

Hollow axles
An axle that has a hole through its centre. Such axles may be tested to a routine, internal, non-destructive testing process.

Inner rim
Inside horizontal surface of the wheel rim.

Inspect / inspection
Determine conformity to required standards.

Interference fit
The shrink or press fit between a wheel centre and a tyre or between the axle and any item, other than a wheelset bearing.

Magnetic particle inspection
Magnetic particle inspection (MPI) is a method of detecting surface, or near surface, discontinuities in magnetisable materials by the generation of a magnetic flux within the material and the application of suitable ferromagnetic particles to the surface, so as to render the discontinuity visible.

Maintenance
The routine process of examination, inspection, measurement and lubrication which, together with the completion of identified repairs, ensures the wheelset remains safe throughout its current service life.
Manufacture
All the processes and assembly operations which culminate in the production of a completely new wheelset.

Monobloc wheel
A wheel comprising a hub, a wheel web and rim with the full wheel tread profile manufactured from a single piece of steel as a single entity.

Non-destructive testing
Non-destructive testing (NDT) is the process of examination of a wheelset to enable its integrity to be assessed by a means which does not compromise the service life or the design life of the wheelset.

Non-passenger vehicle
Vehicles such as locomotives, power cars, driving van trailers and on-track machines that do not carry people other than operational staff in the course of their duties.

Overhaul
Any attention given to the wheelset when it is removed from a vehicle or bogie and when an interference fit is broken (excluding the removal of axle journal bearings).

Passenger vehicle
Vehicles designed and used for carrying passengers who are fare-paying customers.

Personnel vehicles
Vehicles used for the carriage of non-operational staff, including contractors.

Power cars
A non-passenger vehicle which provides, as its principal function, traction power for a trainset of which it is an integral part.

Retaining ring (Gibson ring)
A split ring of material used to retain the tyre on the wheel centre.

Repair
The physical attention given to the wheelset to enable it to remain safe throughout its current service life. Such attention does not require the breaking of any interference fit. Re-profiling of wheel treads is not deemed to be a wheelset repair.

Rolling contact fatigue
A series of fine, typically closely spaced cracks in the centre of the wheel tread which eventually form a complete circumferential band of cracks but may be more extensive.

Roll-over
A burr of extruded material forming on the outer rim side of the wheel during service by plastic deformation.

Service life
The time or distance over which a wheelset safely continues to meet defined technical standards before overhaul is required.

Sharp flange
A sharp corner on the flange tip.
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Technically competent authority
A company, or person, having proven competence in a particular technology or process and being independent of the company requiring the services of the technically competent authority.

Toe radius build-up
Extruded material on the flange tip.

Transverse crack / indication
A linear indication obtained when carrying out NDT which lies transverse to the longitudinal axis of the axle, or which lies at an angle of 45° or greater measured to the longitudinal centre-line.

Tread run-out
The total radial displacement measured at the wheel tread when the wheelset is rotated on rollers supporting the wheelset bearing journals.

Tyred wheel
A wheel which comprises at least a wheel centre and a separately manufactured tyre.

UIC
Union Internationale de Chemins de Fer.

Ultrasonic testing
Ultrasonic testing is a process in which high frequency sound waves are transmitted through materials such that the reflections can be analysed to find imperfections in the material. Ultrasonic axle testing (UAT) is when the process is applied to railway axles.

Wheel centre
The wheel hub, web and rim on which a tyre is fitted.

Wheelset
A complete unit comprising an axle and two complete wheels together with any gear wheels, brake discs, etc, but without axle bearings and their end caps, spacers, seals and other associated fittings. The wheels may be either tyred or monobloc, Figure 1 of this document identifies the relevant features.

Wheelset component / components
These are the individual element(s) that when assembled in accordance with the requirements of the requisite standards produce a wheelset. The constituent components vary for different types of wheelset but typically comprise; axle, monobloc wheel, (or wheel centre, tyre, retaining ring), gear wheel, brake disc, etc.

Wheelset database
A documented, maintained set of up-to-date data for each wheelset design, and each type of vehicle.

Wheel wobble
The total axial displacement of the internal wheel face when the wheelset is rotated, measured at the flange back, measured at 60 mm beneath the flange tip.
References

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from www.rgsonline.co.uk.

Documents referenced in the text

<table>
<thead>
<tr>
<th>Document Code</th>
<th>Description</th>
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<td>RGSC 01</td>
<td>The Railway Group Standards Code</td>
</tr>
<tr>
<td>GM/RT2470</td>
<td>Wheelset Supplier Qualification</td>
</tr>
<tr>
<td>GM/RC2494</td>
<td>Recommendations for Railway Wheelset Design</td>
</tr>
<tr>
<td>GM/RC2495</td>
<td>Recommendations for Railway Wheelset Manufacture</td>
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<td>GM/RC2496</td>
<td>Recommendations for Railway Wheelset Maintenance</td>
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<td>GM/GN2497</td>
<td>Guidance on Railway Wheelset Tread, Gauging and Damage Identification</td>
</tr>
<tr>
<td>GM/GN2498</td>
<td>Guidance on Railway Wheelset Handling [proposed].</td>
</tr>
<tr>
<td>RIS-1530-PLT</td>
<td>Engineering Acceptance of Possession-Only Rail Vehicles and Associated Equipment</td>
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Other references

- AAR Manual of Standards and Recommended Practices - Section G, Part II - Wheel and Axle (Shop) Manual (600 Series)
- BS 5892 Railway Rolling Stock Materials
- BS EN 13103 Railway applications – Wheelset and bogies – Powered axles – Design method
- BS EN 13104 Railway applications – Wheelset and bogies – Non-powered axles - Design method
- BS EN 13260 Railway applications – Wheelsets and bogies – Wheelsets – Product requirement
- BS EN 13261 Railway applications – Wheelsets and bogies – Axles - Product requirement
- BS EN 13262 Railway applications – Wheelsets and bogies – Wheels – Product requirement
- BS EN 13715:2006 Railway applications - Wheelsets and bogies - Wheels - Wheels tread
- BS EN 13979-1 Railway applications - Wheelsets and bogies - Monobloc wheels - Technical approval - Forged and rolled wheels
- M-107/M-208 AAR Manual of Standards and Recommended Practices - Wheels, Carbon Steel
- MT276 Examination Schedule for Preserved Steam Locomotives Running on BR Lines
- UIC 510-2 Trailing stock: wheel and wheelset, condition concerning the use of wheel of various diameters
- UIC 810-1 Technical specification for the supply of rough rolled non-alloy steel tyre for traction and trailing stock
- UIC 813 Technical specification for supply of wheelsets for traction and trailing stock – tolerances and assembly